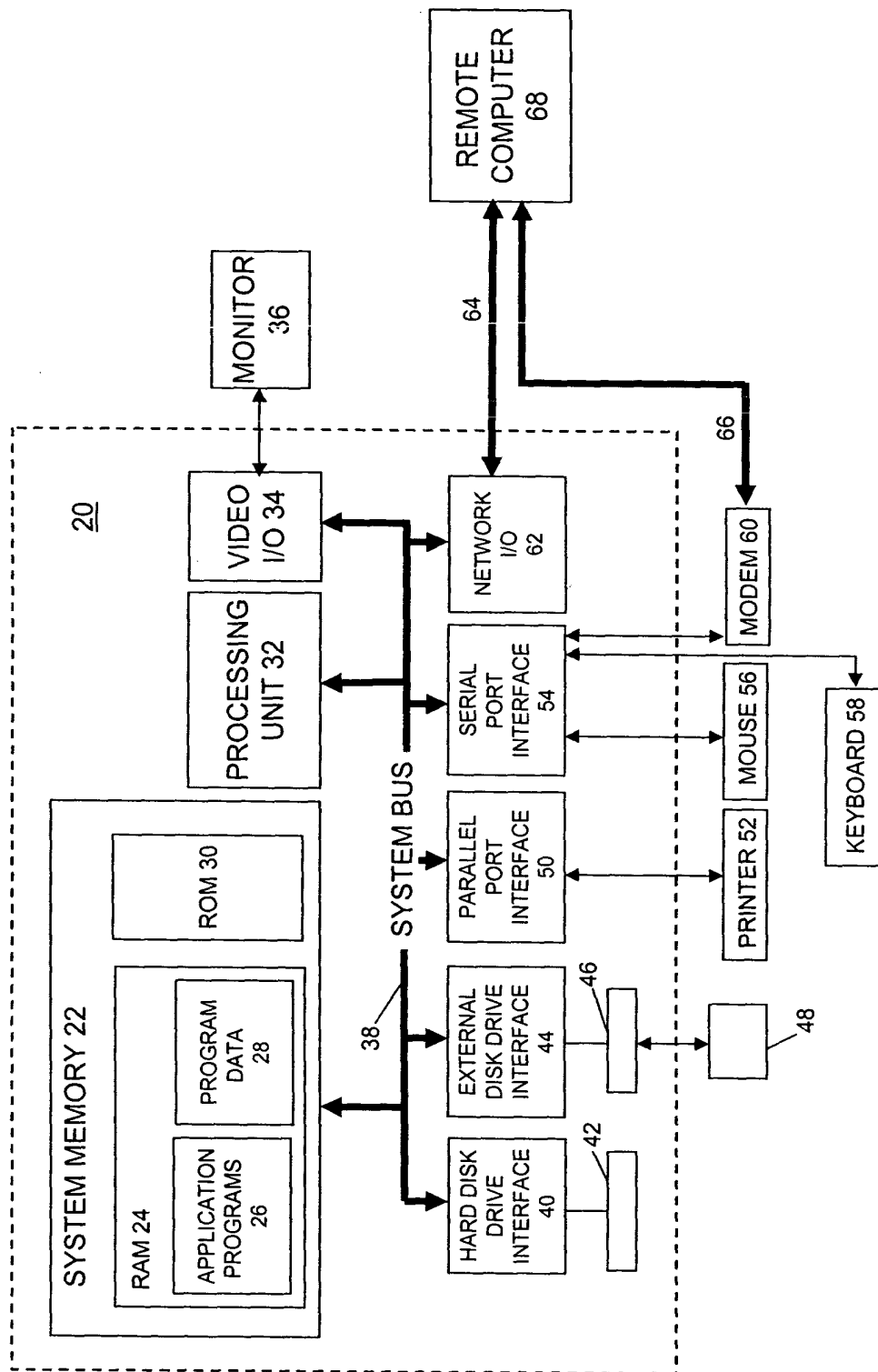


Figure 1



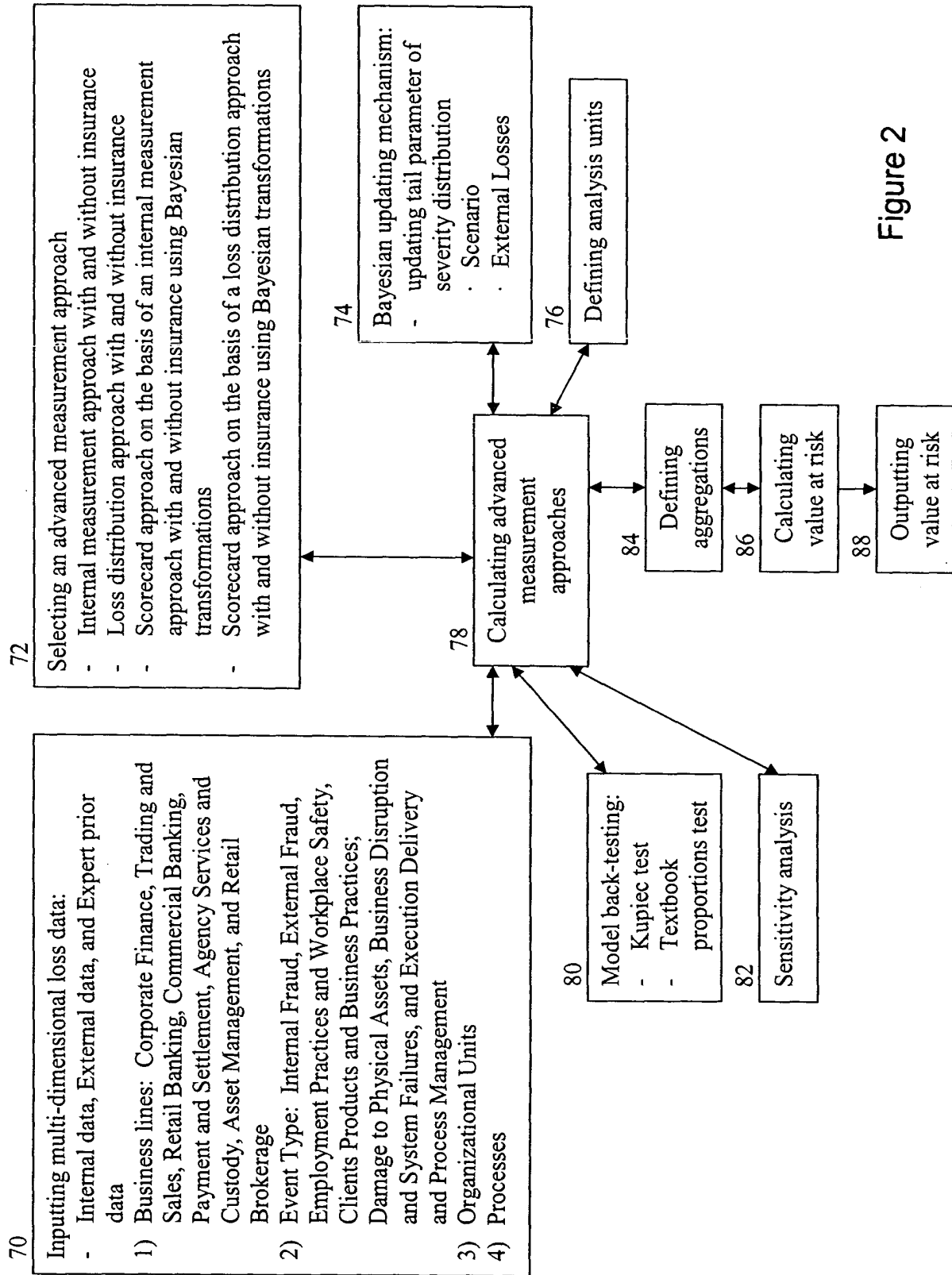


Figure 2

Figure 3

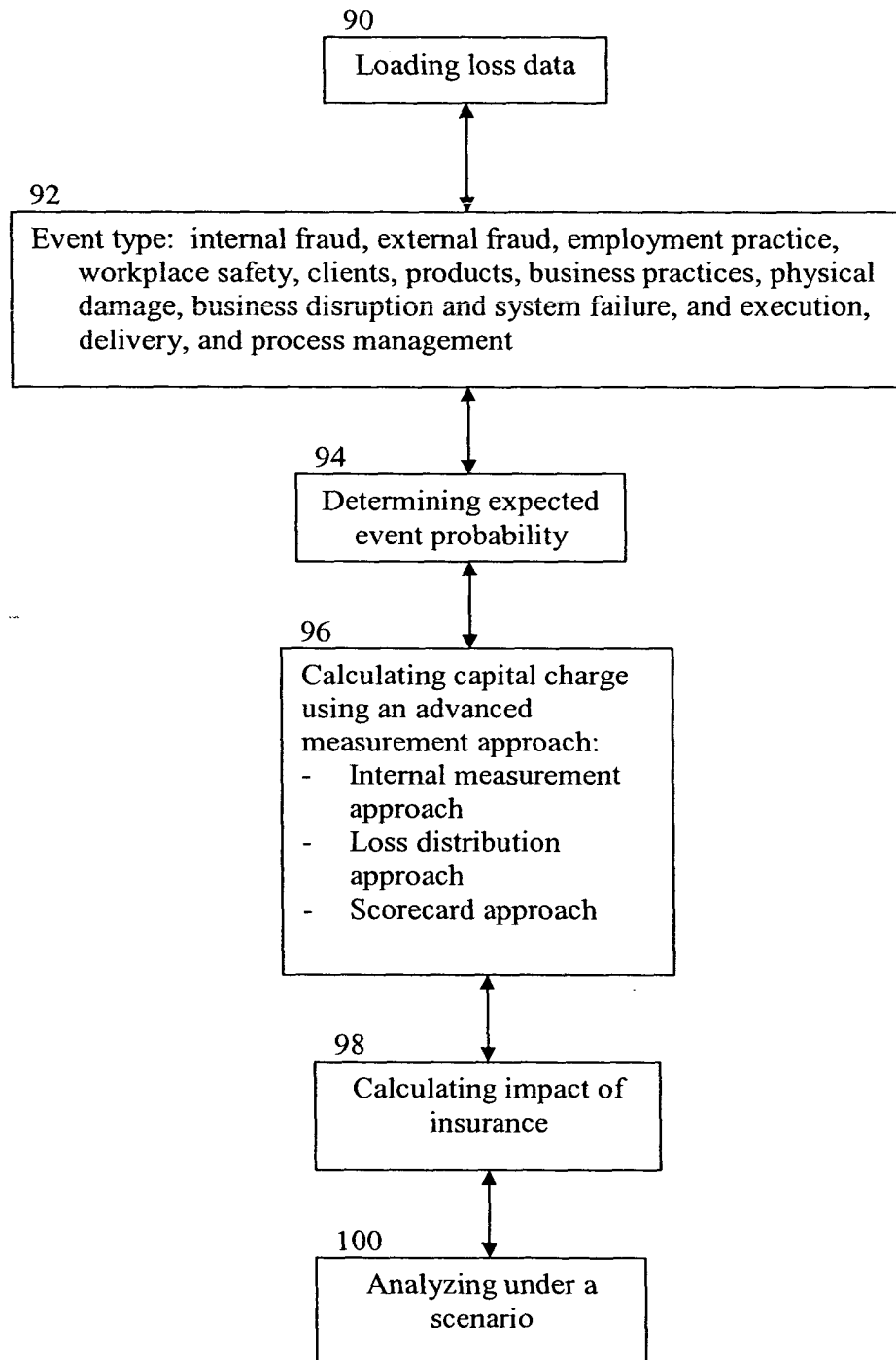


Figure 4

	Advantages	Disadvantages
IMA	<ul style="list-style-type: none"> <li>• Relatively easy to implement</li> <li>• Moderate loss data collection would suffice</li> <li>• Good maintenance properties</li> </ul>	<ul style="list-style-type: none"> <li>• Linear map from expected to unexpected loss required</li> <li>• Tendency of overstating the unexpected loss, thus leading to higher operational capital charge</li> </ul>
LDA	<ul style="list-style-type: none"> <li>• Genuine statistical model to determine the unexpected loss</li> <li>• Good basis for accurate calculation of operational capital charge</li> <li>• High flexibility ensures future validity</li> </ul>	<ul style="list-style-type: none"> <li>• Quite high implementation effort necessary as extensive loss data required (especially delicate for low frequency / high severity events)</li> <li>• Thorough understanding of methodology required to ensure maintenance</li> </ul>

Figure 5

Reduction of mean monthly frequency by	5%	10%	15%	20%	25%	30%
Total number of avoided losses during the 16 months	33.1	66.3	99.45	132.6	165.8	198.9
Mean monthly event frequency	39.37	37.30	35.22	33.15	31.08	29.01
VaR with 99.9% confidence in EUR	15.3 Mio	15.0 Mio	13.0 Mio	12.4 Mio	10.0 Mio	9.1 Mio

Figure 6

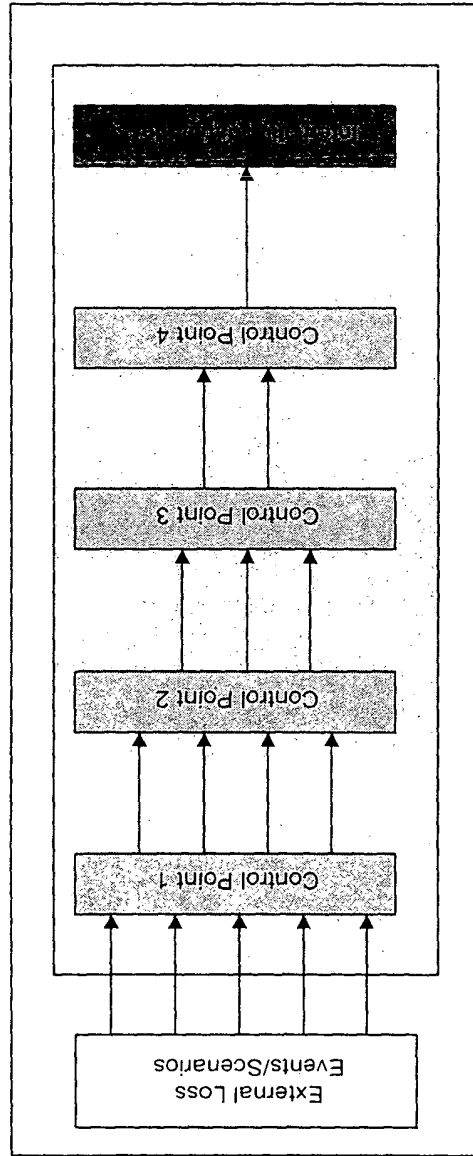


Figure 7

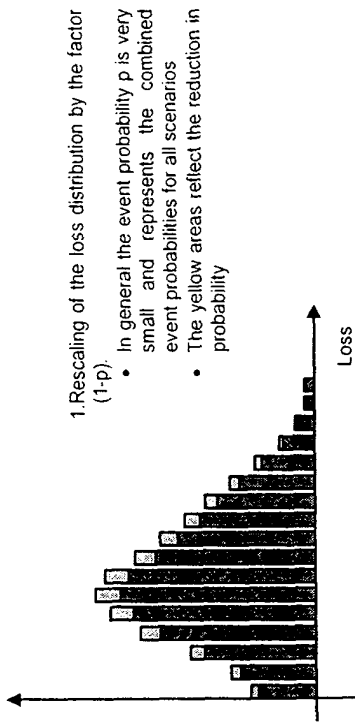
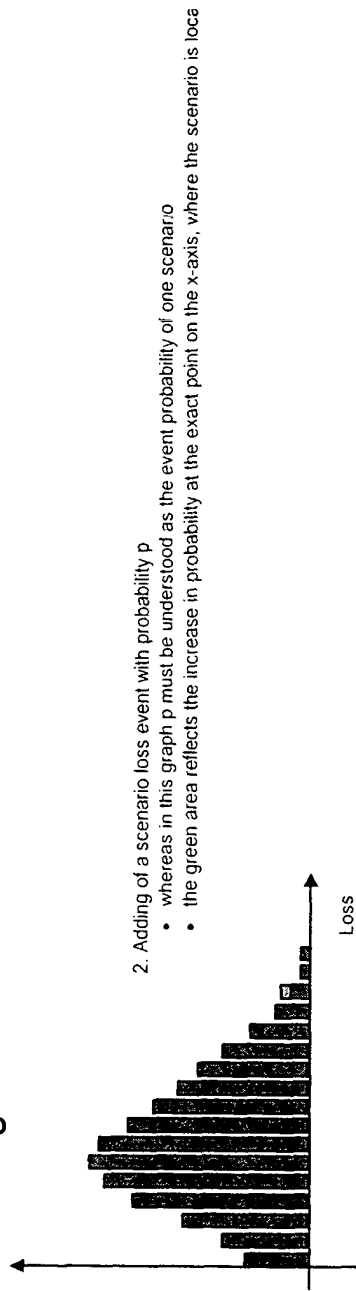


Figure 8



## ORM Functionality Requirements

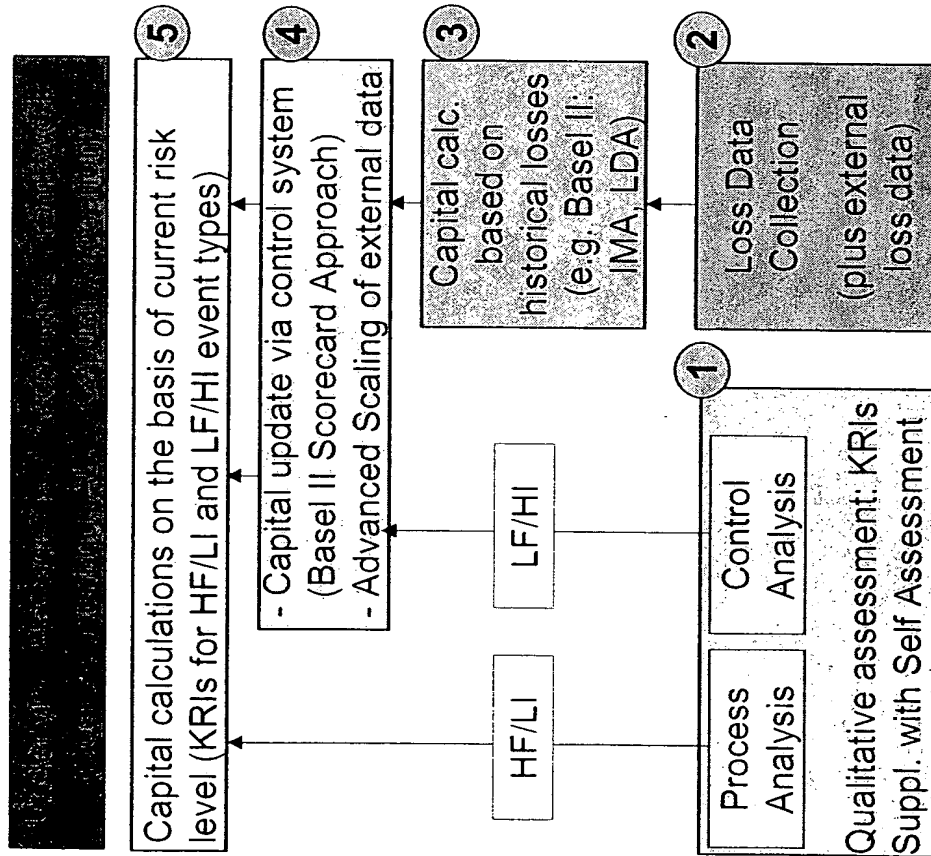


Figure 9

## ORM Methodology\*

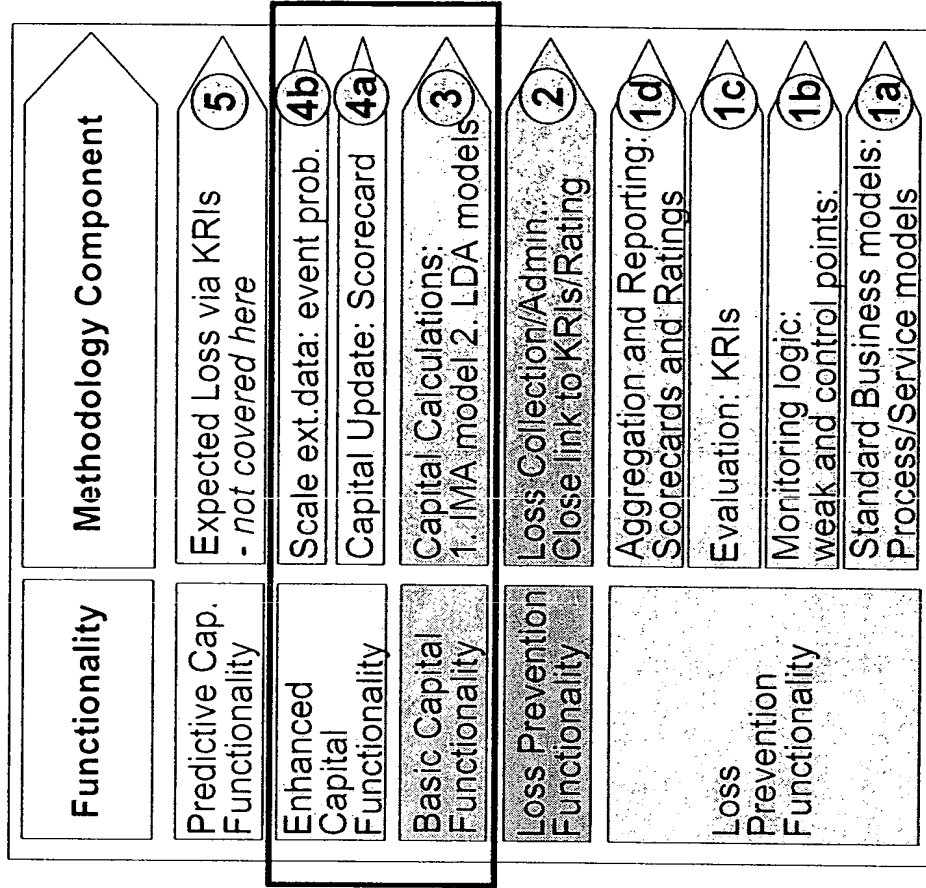




Figure 10

### Basic Capital Calculations (e.g. IMA und LDA)

3

The basic calculation functionality works with historical data only

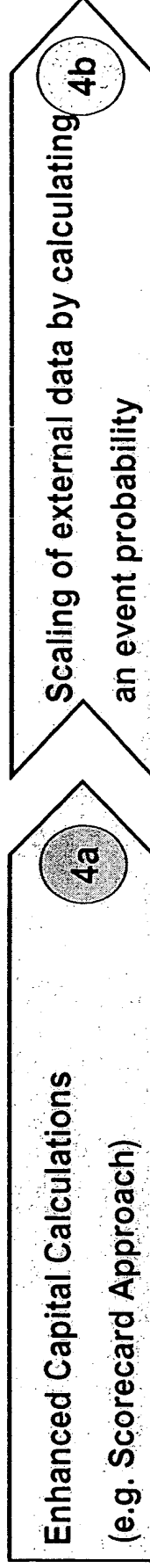
- **IMA:** linear map of expected and unexpected loss:  $K_{ijk} = \gamma_{ijk} \times EI_i \times PE_{ijk} \times LGE_{ijk} = \gamma_{ijk} \times EL_{ijk}$
- **LDA Loss Frequency**
  - Poisson or
  - In the case of Overdispersion: negative binomial
- **LDA Loss Severity:**
  - Lognormal for the body of the distribution
  - Extreme Value Theory for the tail
- Use of (pre-scaled) **external data**
- Inclusion of **insurance** (mathematical representation!)
- **Convolution** into overall loss distribution: Calculation of **VaR, Expected Shortfall, unexpected loss**
- **Flexible bottom-up Aggregation** of Analysis units into capital for the overall bank
  - Regulatory: Basel II-Matrix of 56 nodes
  - Internal MUST: Aggregation according to internal business lines and organizational units
- **Sensitivity analysis and Scenarios** (Stress Testing)

For the tail: Generalized Pareto

$$G_{\xi, \beta}(t) = \begin{cases} 1 - \left( 1 + \frac{\xi(t-u)}{\beta} \right)^{-1/\xi}, & \xi \neq 0 \\ 1 - \exp\left( -\frac{t-u}{\beta} \right), & \xi = 0 \end{cases}$$

*Note:* many banks use qualitative assessments or scalar data for capital allocation purposes of a top-down overall capital. This method is not covered by the prototype as the necessary mathematics and approach are straight-forward, but may differ substantially from bank to bank..

Figure 11



- **Enhanced capital calculation:** Updating the LDA via the risk levels in the control system (Assumption: KRIs and Scorecards in general are more up-to-date than the loss history)
- Two methods are used to update the frequency::
  - **Regression** based on a Poisson or a negative binomial model (depending on LDA used)
  - **Bayes Model, which includes an experts assessment of the risk level via the expected number of events per period:**

$$P(\text{Parameters} | \text{Data}) \propto P(\text{Data} | \text{Parameters})P(\text{Parameters})$$

- **Include Insurance**
- Calculation of VaR etc and aggregation as before

- Includes an extended (more precise) scaling mechanism for external data
  - Pre-scaling of the size of loss (in terms of a max loss)
  - Calculation of a probability of event for the external event via the control system
  - Prerequisite: Consistency in business model used for KRIs and loss collection

Figure 12

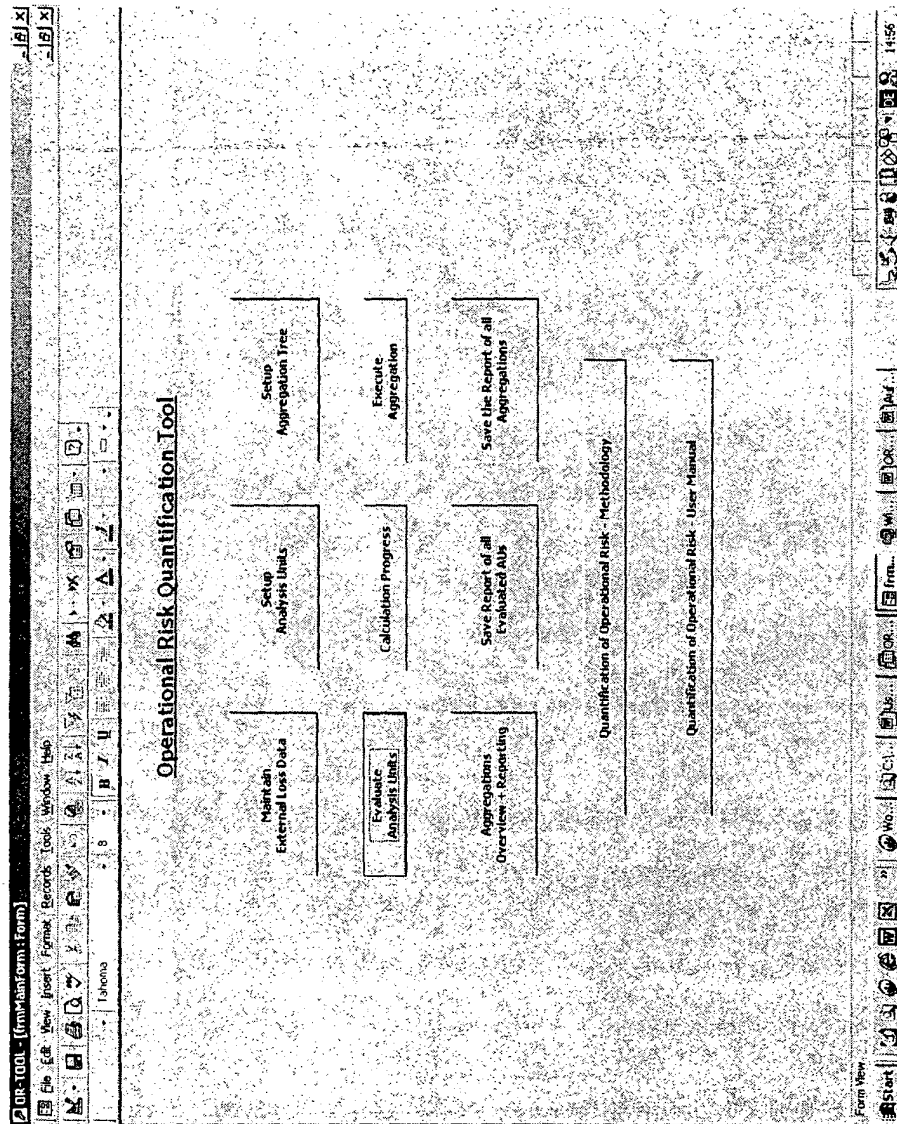


Figure 13

OP-31001 - [InfiniteKnowledgeUnit]

File Edit View Insert Format Records Tools Window Help

MS Sans Serif 8

Please enter a name for the Unit you want to analyze: **Basel1CEFF**

Please choose a Business Line

Corporate Finance  
Trading & Sales  
Retail Banking  
Commercial Banking  
Payment and Settlement  
Agency Services and Custody  
Asset Management  
Retail Brokerage

Please choose an Event

Internal Fraud  
Employment Practices and Workplace  
Clients, Products & Business Practices  
Damage to Physical Assets  
Business Disruption and System Failure  
Execution, Delivery & Process Manage

Please choose a Process

Frontoffice  
Online  
Callcenter

Please choose a Organization

Mid  
Sud  
Ost  
West

Update view on defined Analysis Units

AUName	Business Line	EventName	OrgStructureName	Process
Basel-10-TS-EPW	Trading & Sales	Employment Practices and Workplace Safety	Sud	Backoffice
Basel-10-TS-EPW	Trading & Sales	Employment Practices and Workplace Safety	West	Callcenter
Basel-10-TS-EPW	Trading & Sales	Employment Practices and Workplace Safety	Ost	Callcenter
Basel-10-TS-EPW	Trading & Sales	Employment Practices and Workplace Safety	Ost	Online
Basel-10-TS-EPW	Trading & Sales	Employment Practices and Workplace Safety	Ost	Backoffice
Basel-10-TS-EPW	Trading & Sales	Employment Practices and Workplace Safety	Ost	Frontoffice
Basel-10-TS-EPW	Trading & Sales	Employment Practices and Workplace Safety	West	Frontoffice
Basel-10-TS-EPW	Trading & Sales	Employment Practices and Workplace Safety	Sud	Online
Basel-10-TS-EPW	Trading & Sales	Employment Practices and Workplace Safety	West	Backoffice
Basel-10-TS-EPW	Trading & Sales	Employment Practices and Workplace Safety	Sud	Frontoffice
Basel-10-TS-EPW	Trading & Sales	Employment Practices and Workplace Safety	Nord	Callcenter
Basel-10-TS-EPW	Trading & Sales	Employment Practices and Workplace Safety	Nord	Online
Basel-10-TS-EPW	Trading & Sales	Employment Practices and Workplace Safety	Nord	Backoffice
Basel-10-TS-EPW	Trading & Sales	Employment Practices and Workplace Safety	Nord	Frontoffice
Basel-10-TS-EPW	Trading & Sales	Employment Practices and Workplace Safety	West	Online
Basel-10-TS-EPW	Trading & Sales	Employment Practices and Workplace Safety	West	Callcenter
Basel-10-TS-EPW	Trading & Sales	Employment Practices and Workplace Safety	West	Frontoffice
Basel-10-TS-EPW	Trading & Sales	Employment Practices and Workplace Safety	West	Frontoffice

Record: 14 of 14

Form View

Start

[illegible]

Figure 15

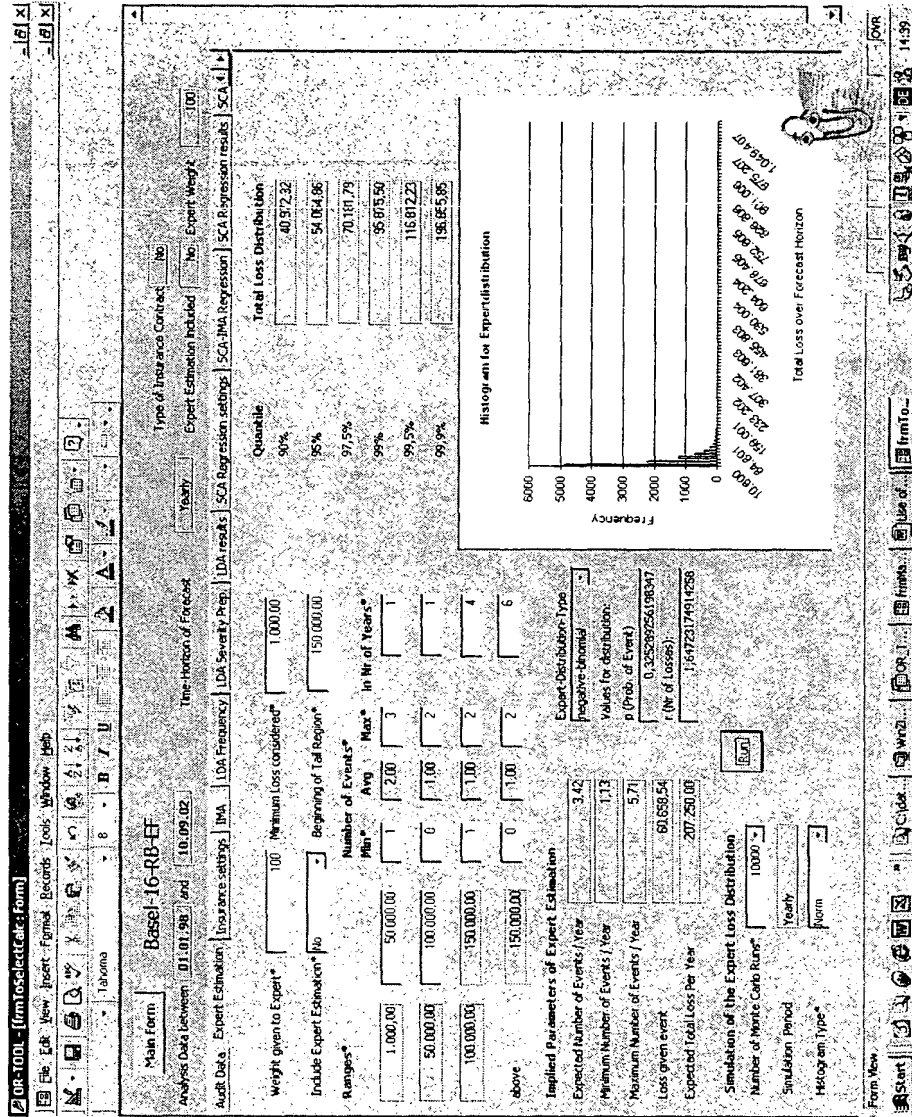


Figure 16

Form View

File Edit View Insert Format Records Tools Window Help

Tabularia

Main Form: Basel-16-RB-EF

Analyze Data between 01.01.98 and 10.09.02

Time Horizon of Forecast: Yearly

Type of Insurance Contract: 1

Expert Estimation included: No

Expert Weight: 100

Auto Data: Expert Estimation Insurance settings: IMA LDA Frequency: LDA Severity Prob: LDA results: SCA Regression settings: SCA Regression results: SCA

Calculated Parameters of Internal Measurement Approach

Expected Number of Events per Yearly: 21.88

Loss given event: 27,497.05

Expected Total Loss per Yearly: 598,251.79

Exposure Indicator: 0.00

Gains: 0.00

Regulatory Capital: 0.00

Upper Bound on the 99.9% Quantile (over 1 year)

Assuming Finite Variance and applying Chebyshev's Inequality: 9,827,134.88

Assuming Finite Variance and Unimodality (Hoschander-Huurn Frequency): 6,790,173.05

Form View

Start End OK Cancel Help

14:44

200-100L - (frmToSelectCalc:form)

File Edit View Insert Format Records Tools Windows Help

MS Sans Serif 8 B I U

Main Form. Basel-16-RB-FF

Analysis Date between 01.01.98 and 10.09.02

Expert Estimation Insurance settings LMA LDA Frequency LDA Results SCA Regression settings SCA Regression results SCA

Type of Insurance Contract 1

Expert Estimation included No Expert Weight 100

Time Horizon of Forecast Yearly

Type of Insurance Contract used for Analysis Unit

Type of Insurance Contract 1

Range of Losses Covered by Insurance

From 1,000.00

To 40,000.00

Proportion of Analysis Unit covered 1

Proportion of Loss covered 1

Type 1: individual insurance cover of severe loss events

Type 2: collective insurance cover for frequent loss events

Form View

Start OK Cancel Help Print

Use of frmTo...



Figure 18

DR-1001 - [frmSelectCalcForm]

File Edit View Insert Format Records Tools Window Help

Tahoma

Main Form: BAS01-16-RB-EF

Analysis Date between 01.01.98 and 10.09.02

Time Horizon of Forecast: 11

Expert Estimation Included: No

Expert Weight: 100

Audit Data: Expert Estimation Insurance settings: IMA LDA Frequency: LDA Severity Prep: LDA results: SCA-IMA Regression SCA Regression results: SCA

Frequency

Poisson Parameter (Lambda): 1.81

Poisson LM Test for Overdispersion: 11.31

Probability for correctness of Poisson Distribution: 0.00000

Z'-second Parameter for Negative Binomial Distribution: 1.24

Recommended Distribution: Negative Binomial

Choice of Distribution: Negative Binomial

Poisson parameter Lambda and Expert Estimation: 1.81

If choice of distribution is changed by user, the updated information is used for the following LDA calculations.

Sum

Form View

Start Close Print Use of Info

14:46

Figure 19

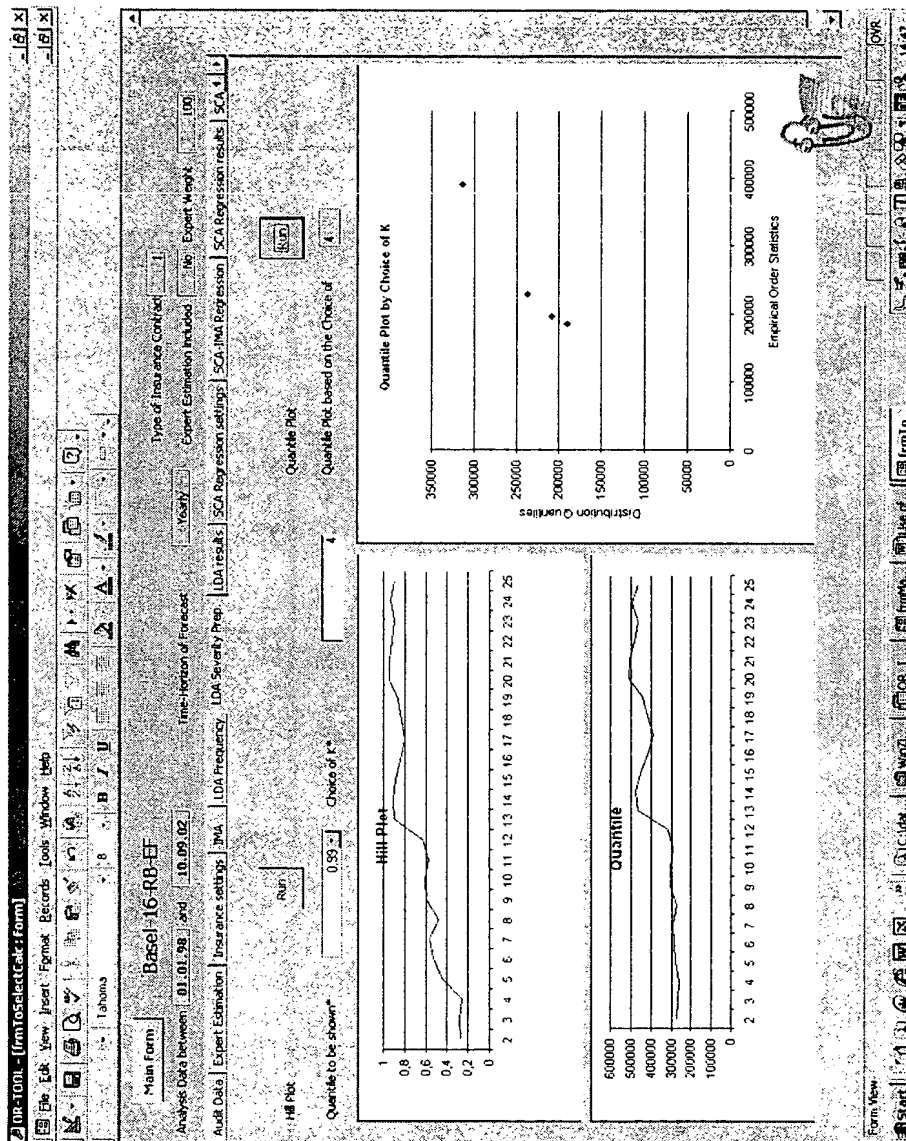


Figure 20

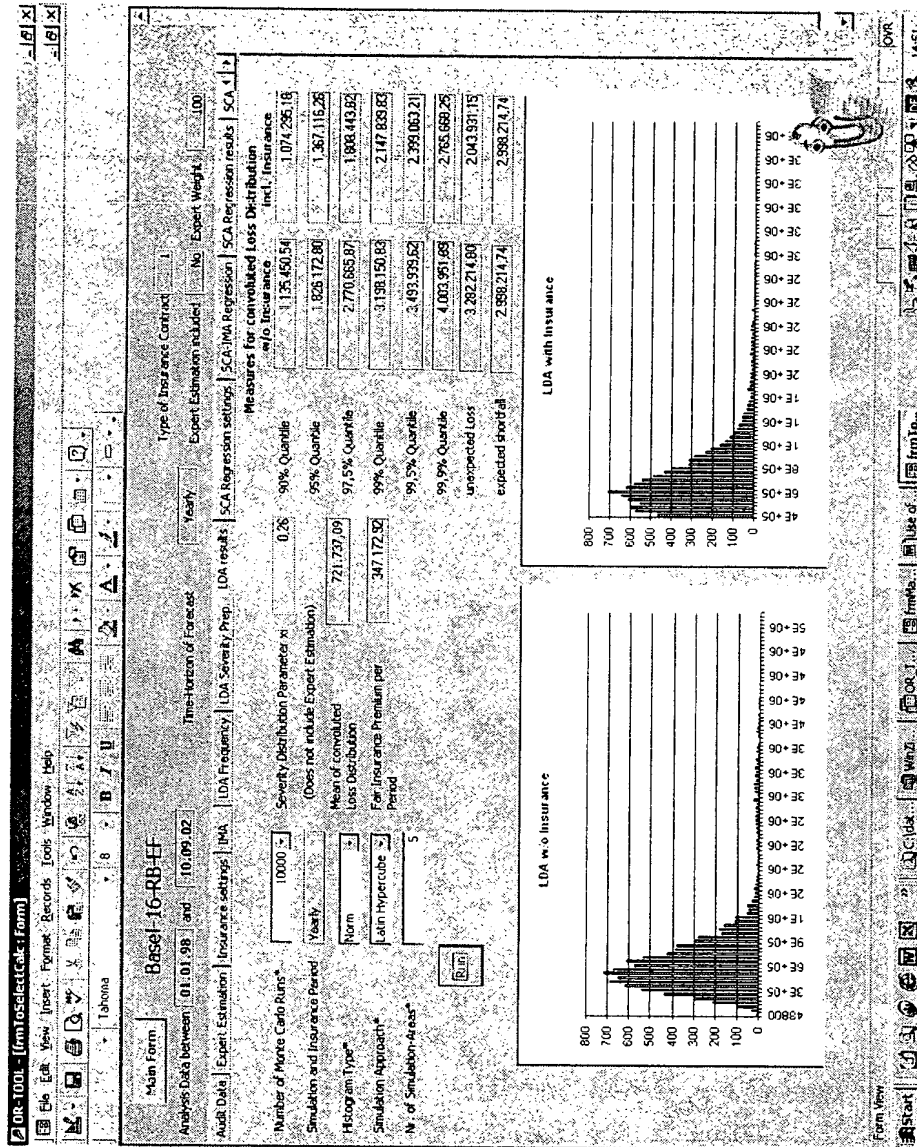


Figure 21

OP-1001 - [frmToSelectCalcForm]  
File Edit View Insert Format Records Tools Window Help  
MS Sans Serif 8 \* B I U \* \* \* \* \*  
Main Form Basel-16-RB-EF  
Analysis Data between 01/01/98 and 10/09/02  
Analysis Data Expert Estimation Insurance Settings IMA LDA Frequency LDA Severity Prep LDA results SCA Regression Settings SCA Regression results SCA  
Type of Insurance Contract 1  
Expert Estimation Included No Expert Weight 100  
Time horizon of Forecast Yearly  
Rating Scenario for previous year  
Month -1\* 1 Month -7\* 3  
Month -2\* 1 Month -8\* 3  
Month -3\* 1 Month -9\* 3  
Month -4\* 2 Month -10\* 3  
Month -5\* 2 Month -11\* 2  
Month -6\* 3 Month -12\* 1  
Rating Scenario for next year (Forecast)  
Actual 1 Month +6\* 1  
Month +1\* 1 Month +7\* 1  
Month +2\* 1 Month +8\* 1  
Month +3\* 1 Month +9\* 1  
Month +4\* 1 Month +10\* 1  
Month +5\* 1 Month +11\* 1  
Run  
Constant Data Regression Approach  
Constant in Poisson Regression 0.30  
Slope in Poisson Regression 0.57  
Standard Deviation of Slope 0.24  
Validity of Rating Significant  
Poisson LM Test for Overdispersion 3.86  
Probability LM Test 0.00  
Negative Binomial Parameter K 0.53  
Recommended Regression Model Poisson  
Choice of Distribution 2  
Actual Rating 1  
Actual Expected Number of Events / Year 14.8022458603233  
Form View  
Start End Copy Paste Undo Redo Print Help  
Case 000 14:55

Figure 22

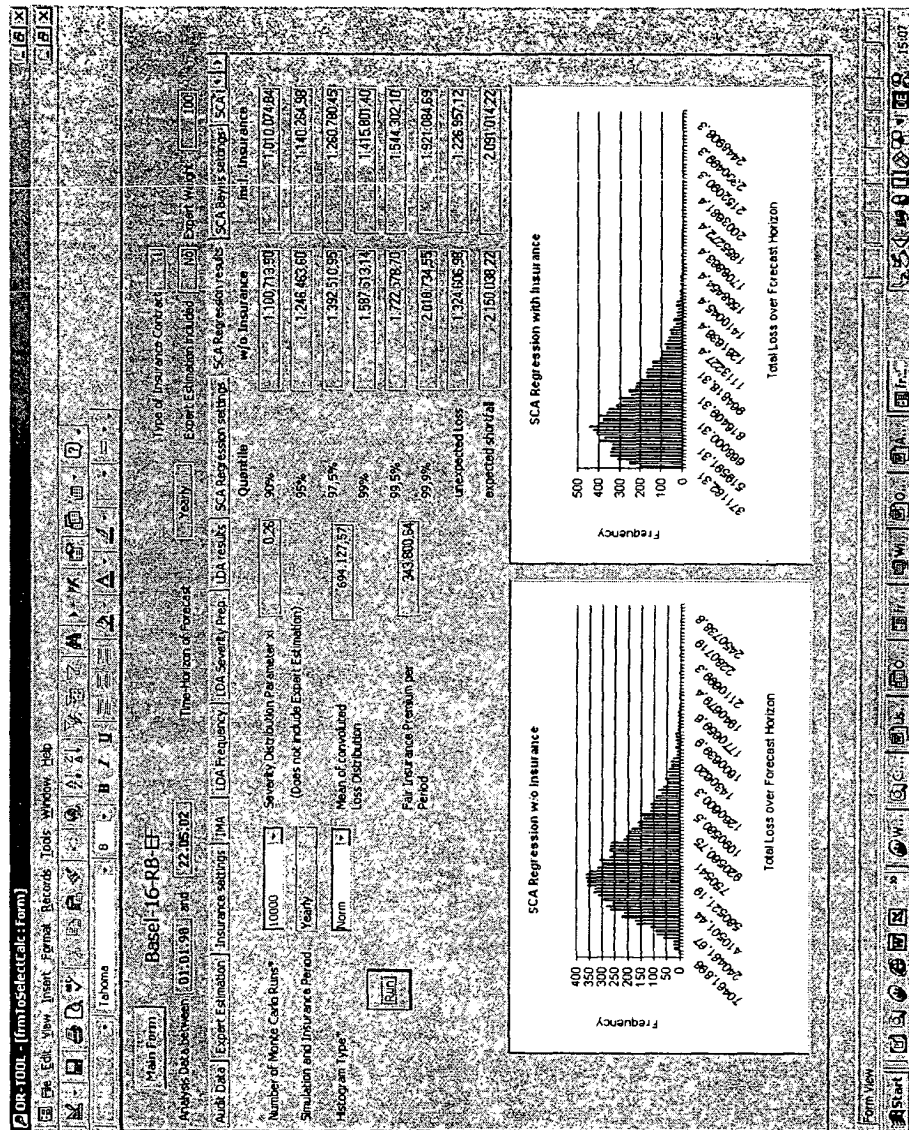


Figure 23

DR-100 - [InfiniteSelectCalcForm]

File Edit View Insert Format Records Tools Window Help

Tahoma 8 B I U

Main form Basel: 16-RB-EF

Analyze Data between 01.01.98 and 10.09.02

Insurance settings: IMA LDA Frequency LDA Severity Prop LDA results SCA Regression settings SCA Regression results SCA Bayes settings SCA MA Bayes

Type of Insurance Contract: 1

Expert Calculation included: No Expert Weight: 100

Time-Horizon of Forecast: Yearly

Positive Case

Prior gamma density parameter Gamma: 0.55

Prior gamma density parameter Beta: 3.29

Prior Mean for Event Frequency mu (calculated for a monthly horizon): 1.81

Prior Variance of Mean sigma<sup>2</sup>: 5.94

Posterior gamma density parameter Gamma: 2.25

Posterior gamma density parameter Beta: 0.77

Posterior Mean for Event Frequency (calculated for a monthly horizon): 1.80

Posterior Variance of Mean: 1.38

Negative binomial Case

Prior beta density parameter a: 1.81

Prior beta density parameter b: 4.14

Prior Mean of Event Probability p (estimated as a the quotient of mu and sigma<sup>2</sup> calculated for a monthly horizon): 0.30

Prior Variance of Event Probability p: 0.03

Variance (Fixed): 5.94

Posterior beta density parameter a: 2.59

Posterior beta density parameter b: 5.94

Posterior Mean of Event Probability (calculated for a monthly horizon): 0.30

Posterior Variance of Probability: 0.02

Updating Mean Information: 1.80

Choice of Distribution: Negative Binomial

Form View

Start OK Cancel Help Use of Infringement

15:08



Figure 24

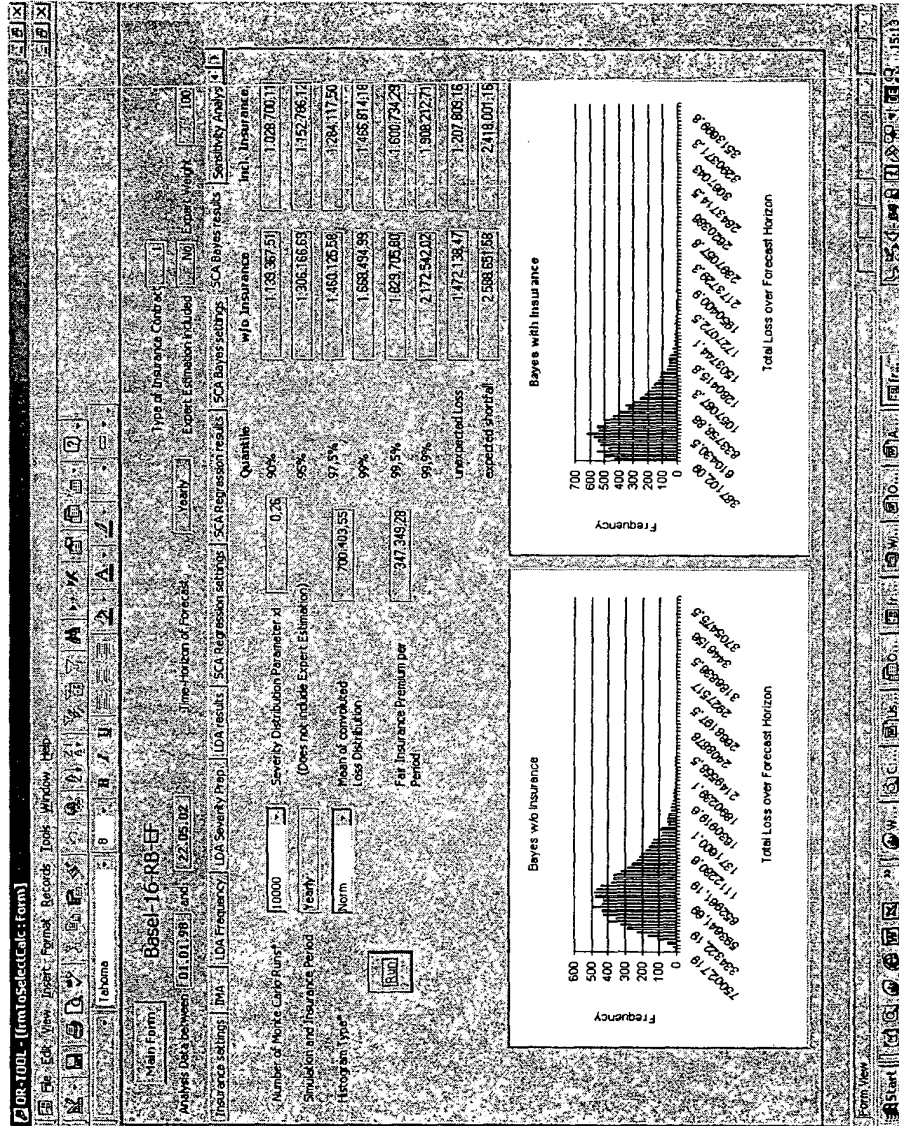
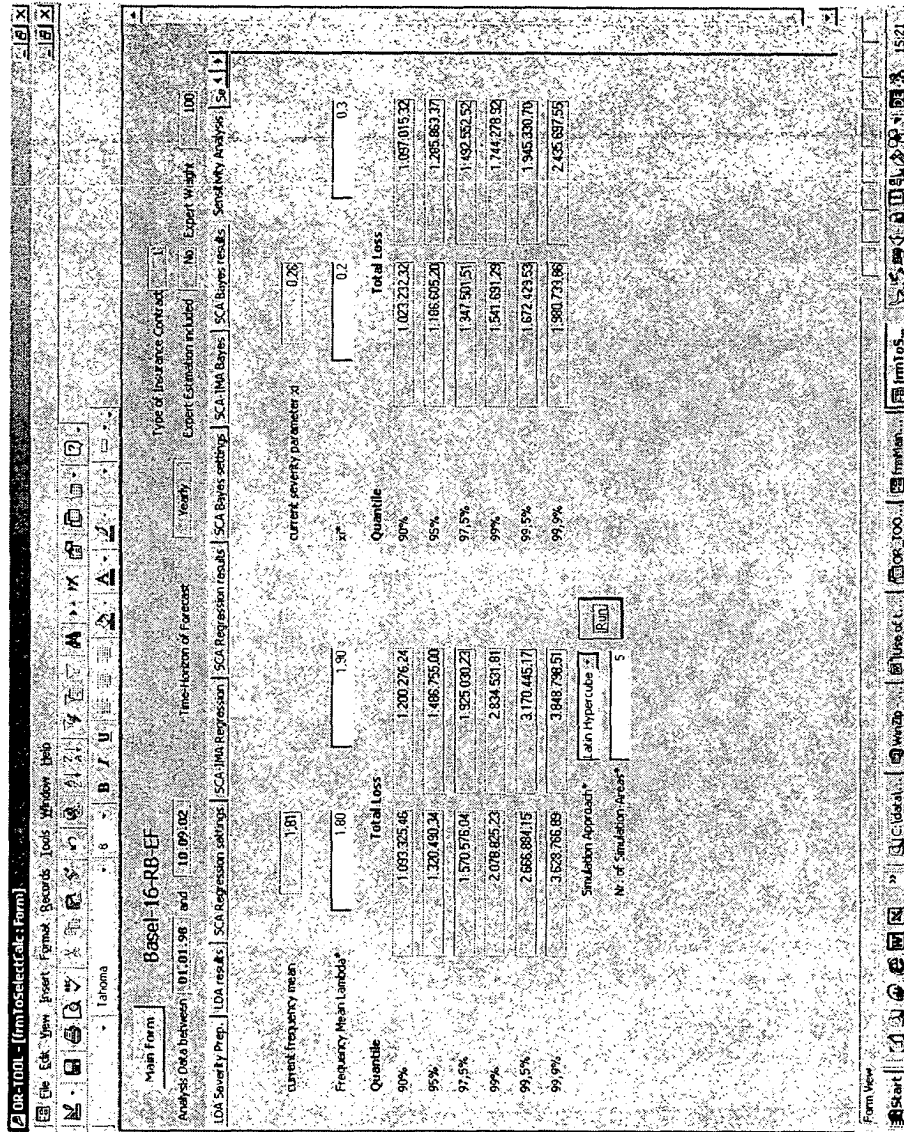


Figure 25





[illegible]

Figure 27

Form View

File Edit View Insert Format Records Tools Window Help

Home

Aggregation Tree Definition

Aggregation level: Level 7

Available sources:

Baseel-10-TS-EPW
Baseel-11-TS-CPPp
Baseel-12-TS-DPA
Baseel-13-TS-BDSF
Baseel-14-TS-EDPM
Baseel-15-RB-IF
Baseel-17-BL-EPW
Baseel-18-RB-CBPp
Baseel-19-RB-DPA
Baseel-1-CF-IF
Baseel-20-RB-BDSF
Baseel-21-RB-EDPM
Baseel-22-CB-IF
Baseel-24-CB-EPW
Baseel-25-CB-CBPp
Baseel-26-CB-DPA
Baseel-27-CB-BDSF
Baseel-28-CB-EDPM
Baseel-29-PS-IF
Baseel-31-PS-EPW

Add =>

<= Delete

Shift source

Shift all

Aggregations:

External Fraud - Investment Banking
External Fraud - Energy
External Fraud - Others

Delete Aggregation Tree ?

Members of selected aggregation:

Baseel-16-GB-EF
Baseel-23-CB-EF
Baseel-30-PS-EF
Baseel-37-ASC-EF

Aggregation name: Create

Form View

Figure 28

DR-100L - [InfiniteAggregation: form]

File Edit View Insert Format Records Tools Window Help

Tahoma 8 B I U A W M Q D

### Aggregation Tree Definition

Aggregation level:

Available sources:

Add -->

<= Delete

Shift source -->

Shift all -->

Aggregation name: Create

Delete Aggregation Tree ?

Members of selected aggregation:

Aggregation: External Fraud - Total

External Fraud - Banking  
External Fraud - Investment Banking  
External Fraud - Others

Form View

Start End Print Copy Paste Undo Redo Zoom In Zoom Out

15:24

Figure 29

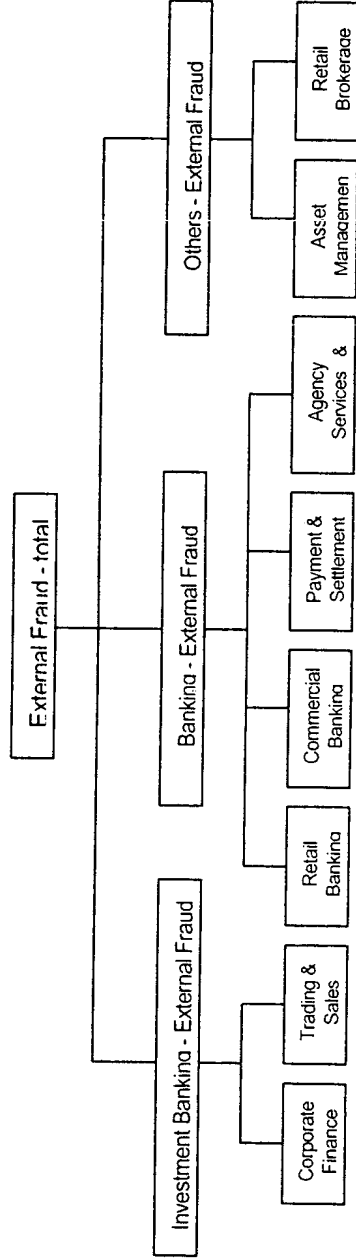


Figure 30

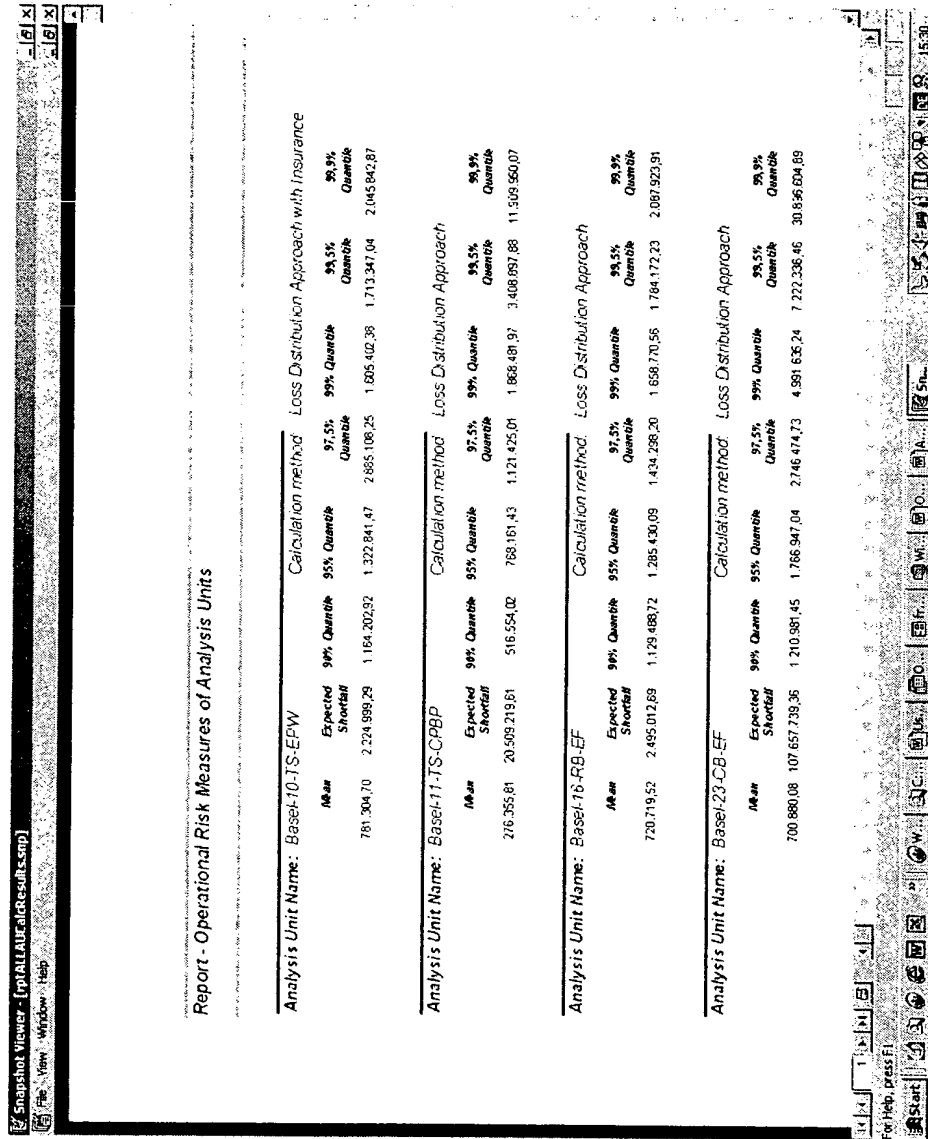


Figure 31

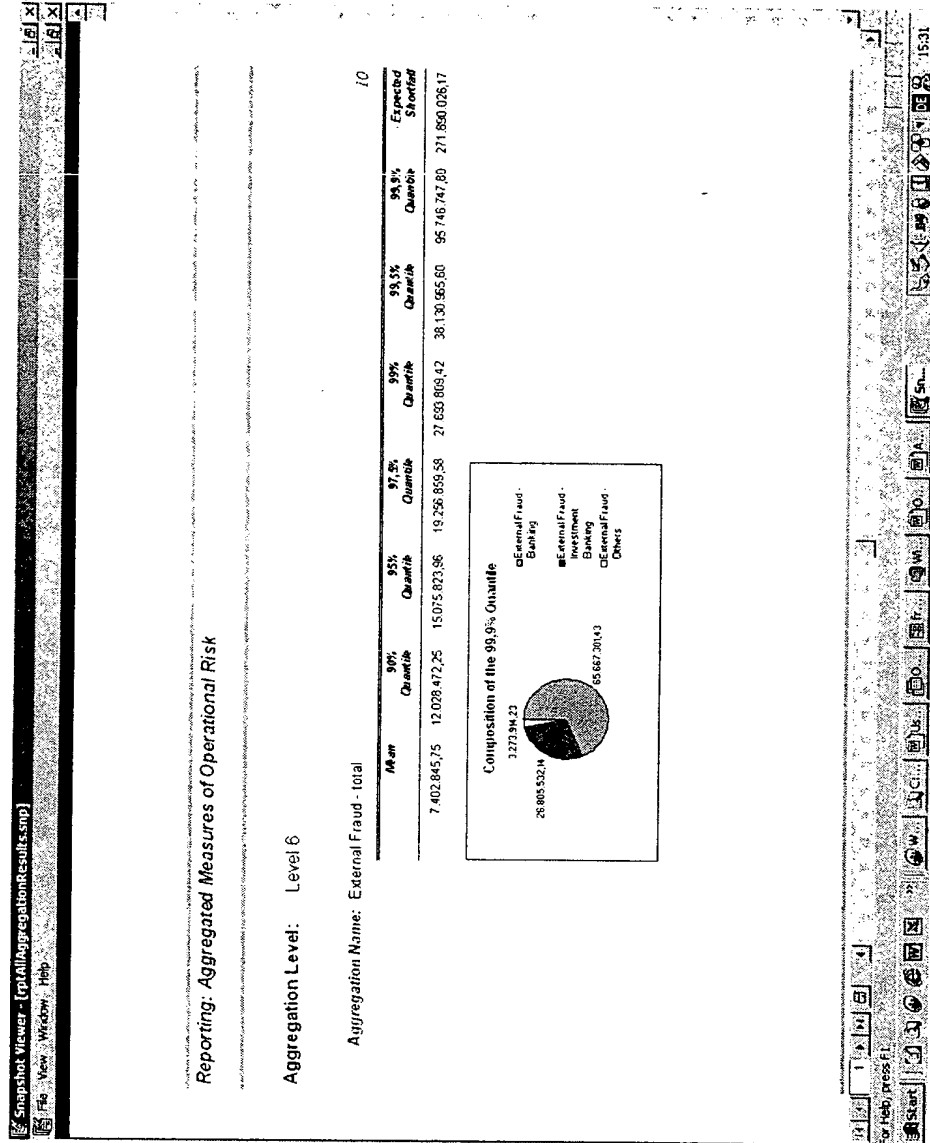


Figure 32

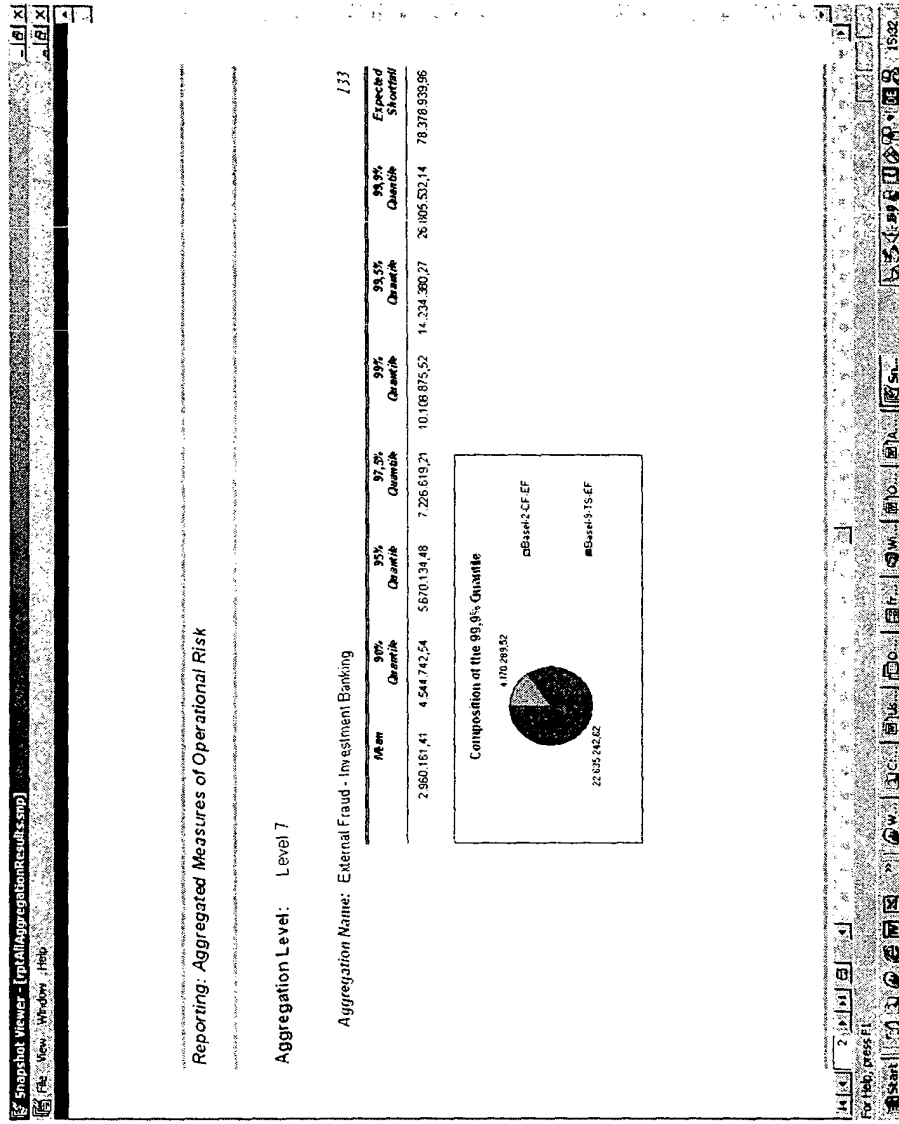


Figure 33

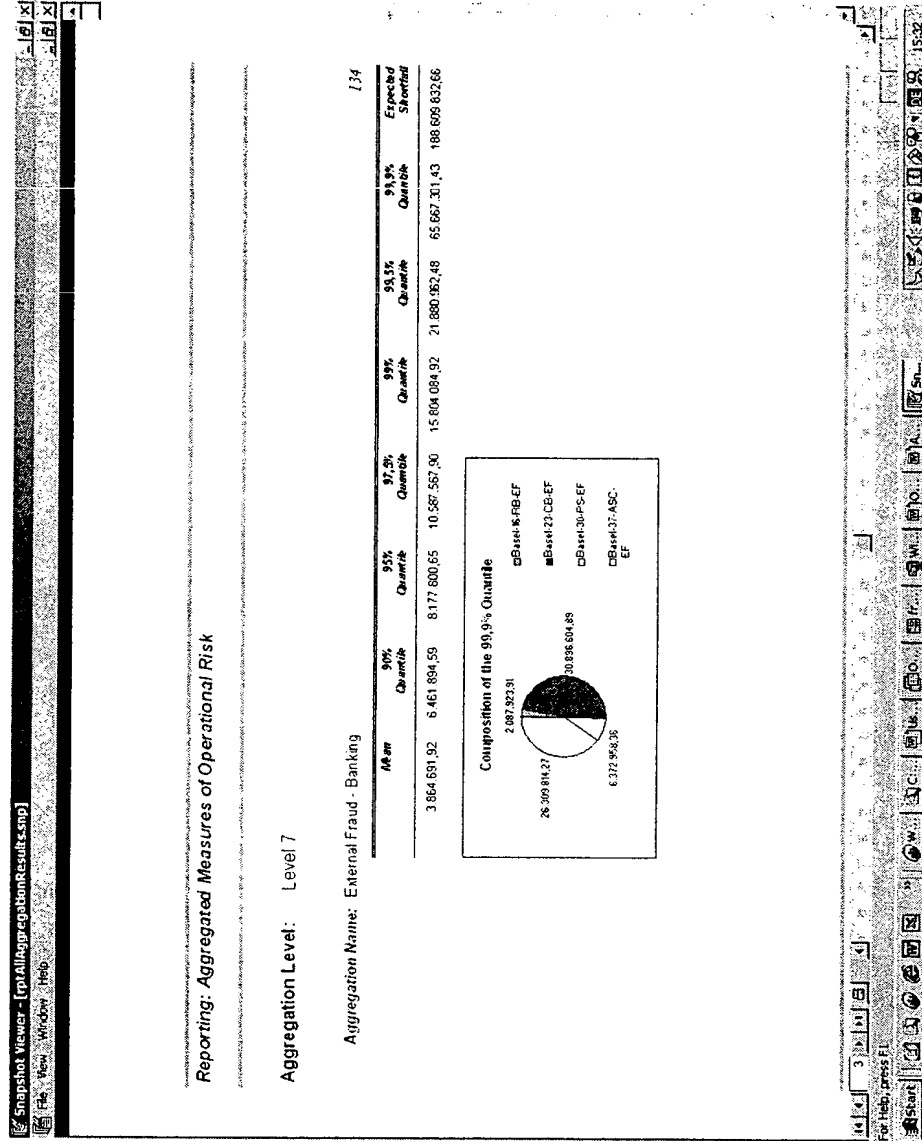




Figure 34

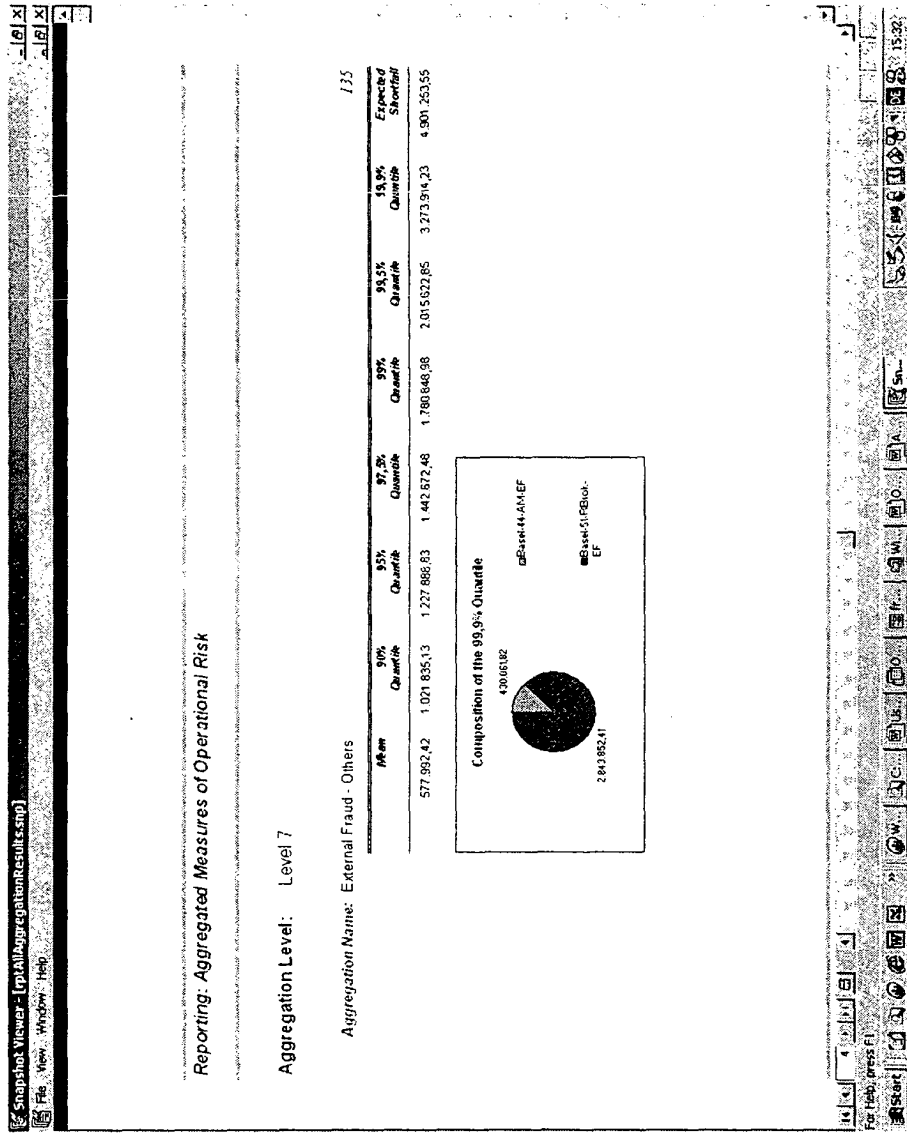


Figure 35

MS-TOOL - [mExtentLosses]

File Edit View Insert Format Records Tools Window Help

MS Sans Serif + 8

Lost/Occurred Date: 8/5/2005

Lost Value: 850026

Business Line: Payment and Settlement

Event Name: External Fraud

Org/Subunit/Line: West

Process: Frontoffice

Lost Description:  
 A former financial adviser was jailed for misappropriation and longer charges relating to the forgery of redemption certificate requests for withdrawal for eight of his clients.

Scaling Description: Scaling: 0.2  
 processes are more manual

Next Record

Form View

Start End Copy Paste Undo Redo Print Close

FormView FormEdit FormPrint FormClose

15:32

Figure 36

DR-100L - (Internal Losses Configured)

File Edit View Insert Format Records Tools Window Help

MS Sans Serif 10

### Defined Properties on Base-Node Level

Relevant Check-Point

Description	mu	sigma
P1: Versicherungsmisch	0.49	0.6
P2: Technischen PM	0.95	0.03
P3: Test3	0.95	0.03
P4: Test4	0.4	0.3
P5: Test5	0.5	0.55

Cut-off value: 100540

BusinessLine: Corporate France  
EventName: Internal Fraud  
OrgStructureName: Nord  
Process: Backoffice  
LoadDocumentDate: 20-Mrz-00

Internal Probability: 0.633221441/219  
Internal Loss Value: 66700  
Loss/Value: 66700

Apply Defined Check-Points:  
☒ Point 1  
☒ Point 2  
☐ Point 3  
☐ Point 4  
☐ Point 5  
☒ Use Data

LossDescription:  
In June 1998, the Personal Investment Authority (PIA) levered a 400,000 GBP line against Financial Options for practices related to pensions not selling. Financial Options was also cited for "grave faults in the firm's recruitment, training, and supervision".

Calculate: Recalculate Internal Probability and Loss Value for Selected BusinessLine/Event Type

Recalculates the Internal Probability and Loss Value for Selected BusinessLine/Event Type

DR-100L - (Internal Losses Configured)

Figure 37

QR-Tool - (IntermediateAnalysisUnit3)

File Edit View Insert Format Records Tools Window Help

MS Sans Serif 8

Already Defined Analysis Units

- Base110TS-EPW
- Base111TS-CPBP
- Base121S-DPA
- Base131S-BDSF
- Base141TS-EDPM
- Base15R8-IF
- Base16R8-EF
- Base17R8-EPW
- Base18R8-CPBP
- Base19R8-DPA
- Base1CF-IF
- Base20R8-BDSF
- Base21R8-EDPM
- Base22CB-IF
- Base23CB-EF
- Base24CB-EPW
- Base25CB-CPBP
- Base26CB-DPA
- Base27CB-BDSF
- Base28CB-EDPM
- Base29PS-IF
- Base30PS-EF
- Base31PS-EPW
- Base32PS-CPBP
- Base33PS-DPA
- Base34PS-BDSF
- Base35PS-EDPM
- Base36-ASC-IF
- Base176SC-EF

Choose Name for new Unit

Please choose a Business Line

- Corporate Finance
- Trading & Sales
- Retail Banking
- Commercial Banking
- Payment and Settlement
- Agency Services and Custody
- Asset Management
- Retail Brokerage

Please choose an Event

- Internal Fraud
- External Fraud
- Employment Practices and Workplace
- Claims, Products & Business Practices
- Damage to Physical Assets
- Business Disruption and System Failure
- Execution, Delivery & Process Manage

Please choose an Organization

- North
- South
- East
- West

Please choose a Process

- Frontoffice
- Backoffice
- Online
- Callcenter

Form View

Start Undo Redo Cut Copy Paste Print Close Quit

Doc 100 Doc 101 Doc 102 Doc 103 Doc 104 Doc 105 Doc 106 Doc 107 Doc 108 Doc 109 Doc 110 Doc 111 Doc 112 Doc 113 Doc 114 Doc 115 Doc 116 Doc 117 Doc 118 Doc 119 Doc 120 Doc 121 Doc 122 Doc 123 Doc 124 Doc 125 Doc 126 Doc 127 Doc 128 Doc 129 Doc 130 Doc 131 Doc 132 Doc 133 Doc 134 Doc 135 Doc 136 Doc 137 Doc 138 Doc 139 Doc 140 Doc 141 Doc 142 Doc 143 Doc 144 Doc 145 Doc 146 Doc 147 Doc 148 Doc 149 Doc 150 Doc 151 Doc 152 Doc 153 Doc 154 Doc 155 Doc 156 Doc 157 Doc 158 Doc 159 Doc 160 Doc 161 Doc 162 Doc 163 Doc 164 Doc 165 Doc 166 Doc 167 Doc 168 Doc 169 Doc 170 Doc 171 Doc 172 Doc 173 Doc 174 Doc 175 Doc 176 Doc 177 Doc 178 Doc 179 Doc 180 Doc 181 Doc 182 Doc 183 Doc 184 Doc 185 Doc 186 Doc 187 Doc 188 Doc 189 Doc 190 Doc 191 Doc 192 Doc 193 Doc 194 Doc 195 Doc 196 Doc 197 Doc 198 Doc 199 Doc 200 Doc 201 Doc 202 Doc 203 Doc 204 Doc 205 Doc 206 Doc 207 Doc 208 Doc 209 Doc 210 Doc 211 Doc 212 Doc 213 Doc 214 Doc 215 Doc 216 Doc 217 Doc 218 Doc 219 Doc 220 Doc 221 Doc 222 Doc 223 Doc 224 Doc 225 Doc 226 Doc 227 Doc 228 Doc 229 Doc 230 Doc 231 Doc 232 Doc 233 Doc 234 Doc 235 Doc 236 Doc 237 Doc 238 Doc 239 Doc 240 Doc 241 Doc 242 Doc 243 Doc 244 Doc 245 Doc 246 Doc 247 Doc 248 Doc 249 Doc 250 Doc 251 Doc 252 Doc 253 Doc 254 Doc 255 Doc 256 Doc 257 Doc 258 Doc 259 Doc 260 Doc 261 Doc 262 Doc 263 Doc 264 Doc 265 Doc 266 Doc 267 Doc 268 Doc 269 Doc 270 Doc 271 Doc 272 Doc 273 Doc 274 Doc 275 Doc 276 Doc 277 Doc 278 Doc 279 Doc 280 Doc 281 Doc 282 Doc 283 Doc 284 Doc 285 Doc 286 Doc 287 Doc 288 Doc 289 Doc 290 Doc 291 Doc 292 Doc 293 Doc 294 Doc 295 Doc 296 Doc 297 Doc 298 Doc 299 Doc 300 Doc 301 Doc 302 Doc 303 Doc 304 Doc 305 Doc 306 Doc 307 Doc 308 Doc 309 Doc 310 Doc 311 Doc 312 Doc 313 Doc 314 Doc 315 Doc 316 Doc 317 Doc 318 Doc 319 Doc 320 Doc 321 Doc 322 Doc 323 Doc 324 Doc 325 Doc 326 Doc 327 Doc 328 Doc 329 Doc 330 Doc 331 Doc 332 Doc 333 Doc 334 Doc 335 Doc 336 Doc 337 Doc 338 Doc 339 Doc 340 Doc 341 Doc 342 Doc 343 Doc 344 Doc 345 Doc 346 Doc 347 Doc 348 Doc 349 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Figure 38

DR-1001 - (Initial Selection Form)

File Edit View Insert Format Records Tools Window Help

Table

Basel-16-RB-EF

Analysis Data between 01.01.98 and 30.09.02

Analysis Data Expert Estimation Insurance settings IMA LDA Frequency LDA Severity Prop LDA results SCA Regression settings SCA Regression results SCA

Calculated Parameters of Internal Measurement Approach for time horizon Yearly

Expected Number of Events in time horizon (as calculated from Regression settings) 14.95

Loss given event 27,497.05

Expected Total Loss per time horizon 407,018.19

Run

Form View

DR 15:08

Figure 39

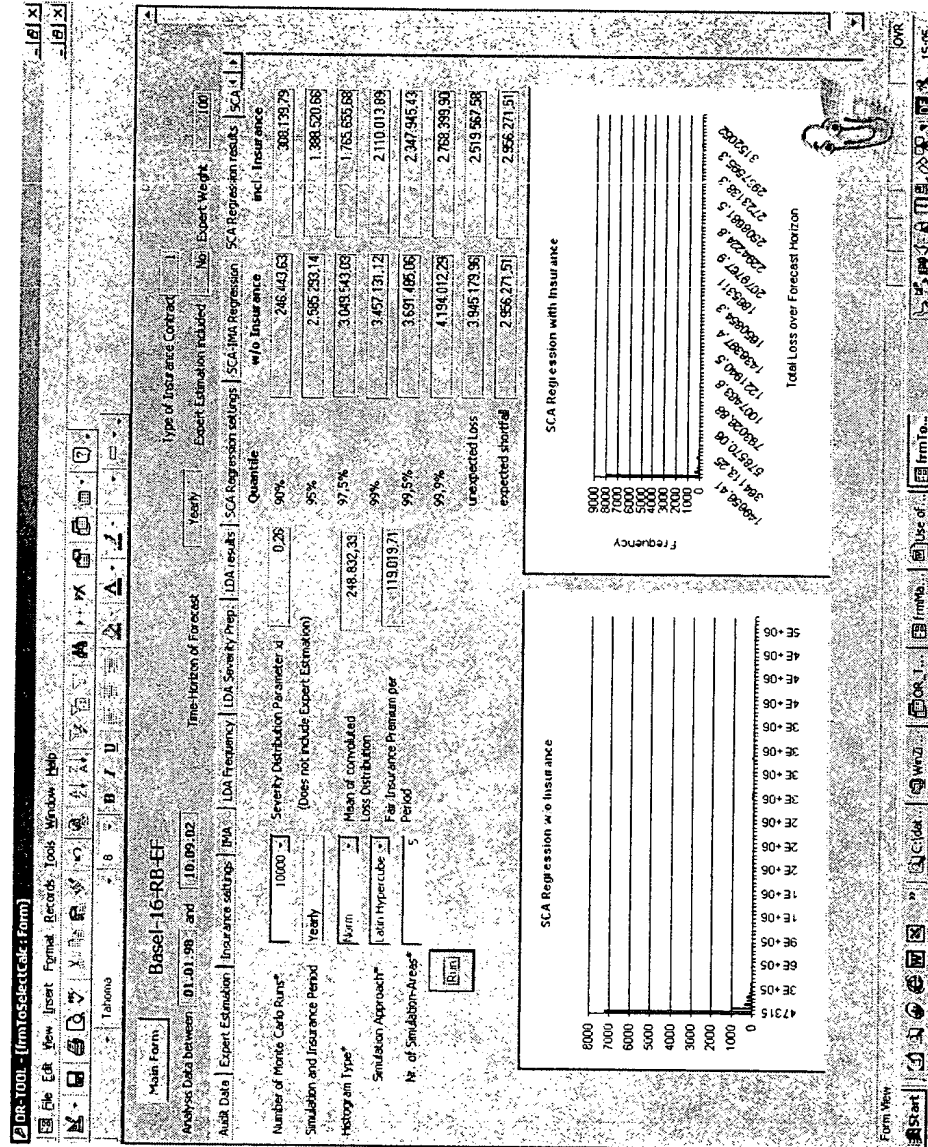


Figure 40

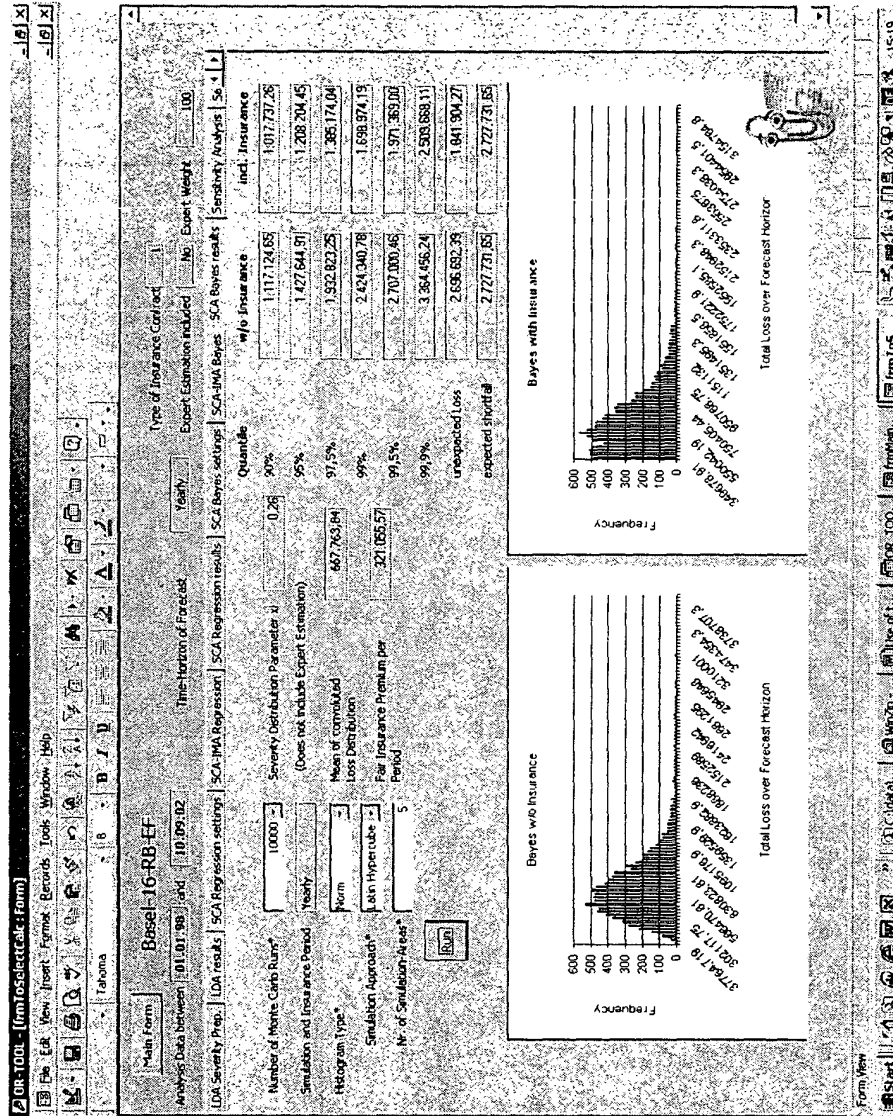


Figure 41

002-1001 - (frmAggregationsOverview.frm)

File Edit View Insert Format Records Tools Window Help

Form View

### Overview - Aggregations

Aggregation Level 7 External Fraud - Investment B External Fraud - Banking External Fraud - Others	Aggregation Level 6 External Fraud - Total	Aggregation Level 5	Aggregation Bank Level
Level 7 Report	Level 6 Report	Level 5 Report	Bank Level Report
Aggregation Level 4	Aggregation Level 3	Aggregation Level 2	
Level 4 Report	Level 3 Report	Level 2 Report	

Form View

Start Print View Print Preview Print Setup Print Range Print All Print Page Print Page Range Print Page Range

002-1001 15:23



Figure 42

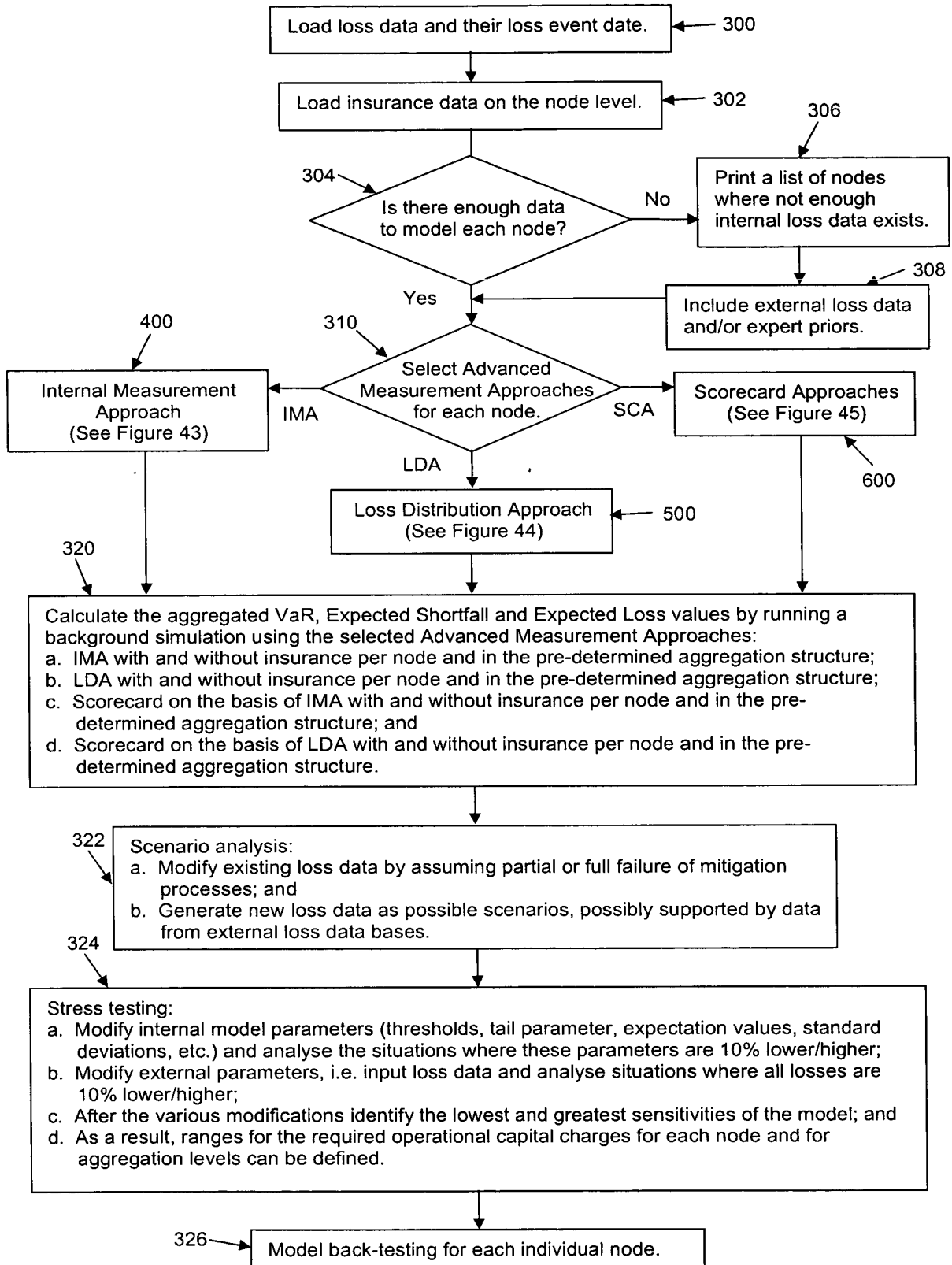


Figure 43

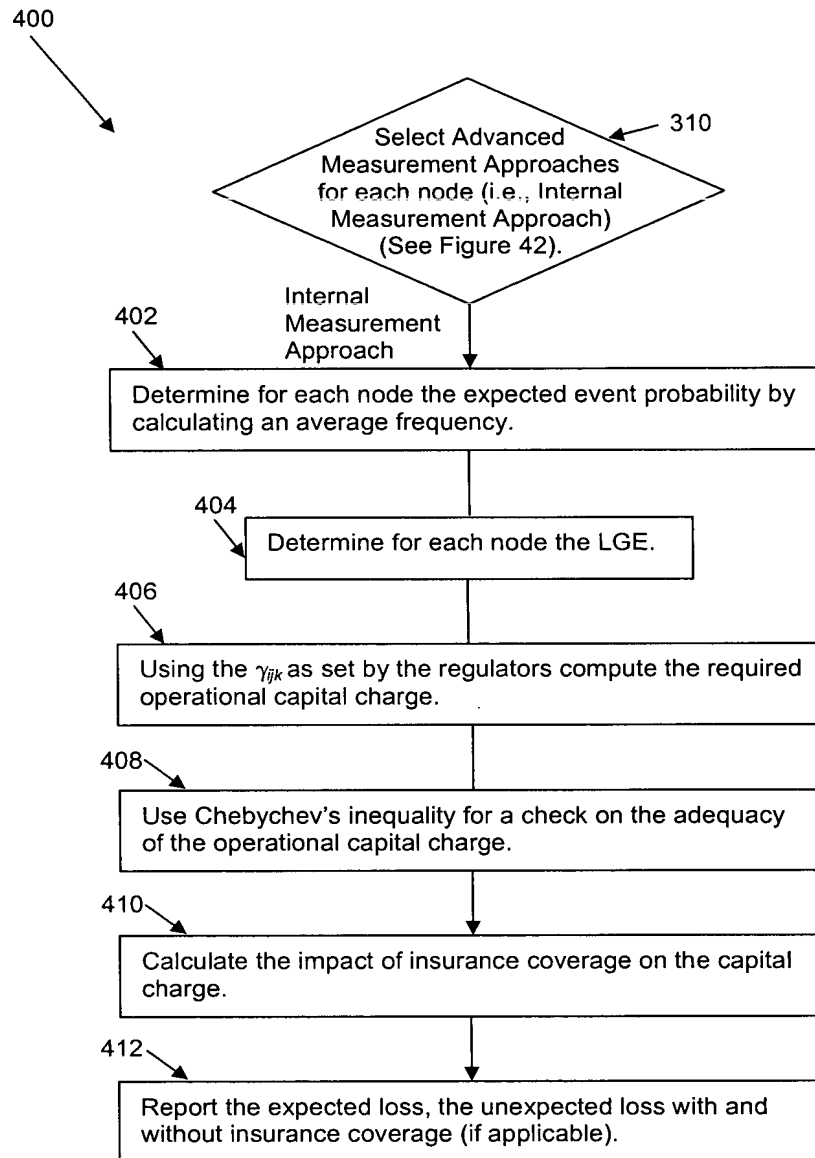


Figure 44

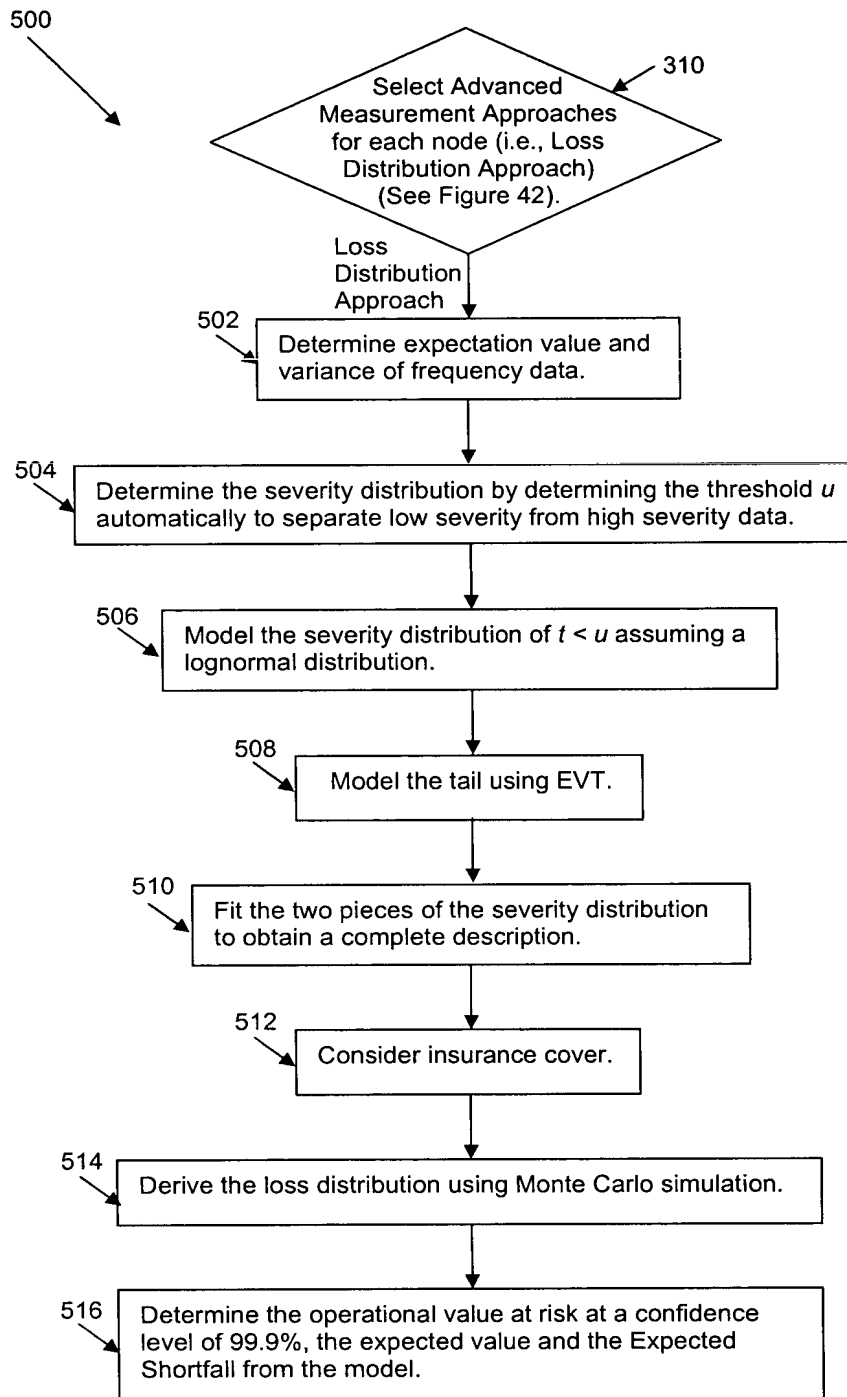


Figure 45

